Southern California Riparian Habitats

Climate Change Vulnerability Assessment Summary

An Important Note About this Document: *This document represents an initial evaluation of vulnerability for riparian habitats based on expert input and existing information. Specifically, the information presented below comprises habitat expert vulnerability assessment survey results and comments, peer-review comments and revisions, and relevant references from the literature. The aim of this document is to expand understanding of habitat vulnerability to changing climate conditions, and to provide a foundation for developing appropriate adaptation responses.*

Habitat Description

Southern California riparian habitats vary widely with regard to species composition, geomorphology, and hydrologic regimes. For the purposes of this assessment, discussion will be limited to three focal types of low-gradient riparian habitats: vernal pools, springs, and wet meadows. These categories include both precipitation- and groundwater-dominated systems, and they are frequently characterized by a high water table, periodic flooding, hydric and/or mesic vegetation, and the presence of rare, endemic, and threatened or endangered species adapted to these habitat types.[1–3] Southern California vernal pools are ephemeral wetlands that occur in soils with low permeability in bedrock depressions, inland valleys, and coastal or inland mesas.[4] Vernal pool hydrology is entirely dependent on precipitation, and pools cycle between annual periods of flooding and drying.[1] Springs are created by the upwelling of groundwater to the surface, and outflows typically form isolated pools or feed into streams.[3] Discharge volume, temperature, and water chemistry create unique systems around springs that often support very high levels of biodiversity.[3] Wet meadows typically occur at high elevations where the water table is near the surface, and are dominated by herbaceous species that tap into the groundwater; they can be further classified based on factors such as substrate, water source, topography, and vegetation.[2]

Habitat Vulnerability

Moderate Vulnerability

Moderate Confidence

The relative vulnerability of riparian habitats in southern California was evaluated to be moderate by habitat experts due to moderate-high sensitivity to climate and non-climate stressors, high exposure to future climate changes, and moderate adaptive capacity. Within arid and semi-arid regions such as southern California, riparian habitats are critically sensitive to changes in the amount, source, and duration of water within a system, which can alter hydrologic and flooding regimes. Habitats that rely solely on precipitation are most sensitive to changes in the amount or timing of rain and snow, while groundwater-dependent systems such as springs may be less immediately responsive to changes. Drought conditions have widespread

effects on all system types, and may shift species composition towards vegetation that can tolerate drier conditions. Severe flooding can cause erosion and channel entrenchment that may alter habitat structure and function, and wildfire greatly increases the risk of flash flooding and debris flows. Climate vulnerabilities in riparian habitats are further exacerbated by habitat degradation or loss due to anthropogenic stressors. Many riparian habitats have already been lost or heavily degraded by factors that alter their hydrological regime, including development, invasive species, and grazing. Although riparian habitats are adapted to variable conditions as a whole, degraded systems may be unable to recover from disturbance such as these, and management intervention may be needed to restore normal system processes (e.g., flooding regimes and sediment transport). Riparian habitats support very high numbers of endemic and threatened/endangered species due to their unique conditions and isolated nature. They provide valuable ecosystem services including the provision of clean water, flood control, and sediment transport.

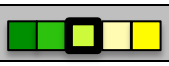
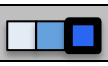
Sensitivity

Moderate-High Sensitivity

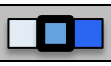
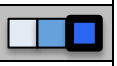
Moderate Confidence

Riparian habitats are sensitive to multiple climate drivers, including precipitation, drought, low stream flows, soil moisture, snowpack depth, and timing of snowmelt and runoff. Overall, riparian habitats are dynamic systems accustomed to frequent disturbances;[5] however, changes in hydrology due to climate stressors and/or anthropogenic activity can significantly degrade the habitat by altering both structure and function.[6–8]

Habitat sensitivity factors and impacts*

CLIMATIC DRIVERS	Moderate Sensitivity  High Confidence 
Precipitation & soil moisture	The amount and timing of precipitation, which is closely tied to soil moisture, is one of the primary drivers of riparian hydrology.[3,6,9] Precipitation-dominated riparian systems are more sensitive to changes than groundwater-dependent systems, since they rely entirely on rain and snow for inundation and water storage.[1,10,11] Shifts in precipitation and soil moisture may result in: • Shifts in vegetation community composition[3,7,10,12] • Changes in water quality and/or chemistry associated with increased runoff[3] • Altered timing and duration of inundation in vernal pools, affecting invertebrate and amphibian survival/reproduction[1,13] • Change in spring discharge rates[3,9]
Drought	Although riparian systems are adapted to periods of summer drought, increasingly severe and/or longer-duration droughts may cause: • Altered water chemistry due to concentrated dissolved minerals and salts[3] • Extirpation of aquatic species where pools and standing water dry up[6] • Compositional shifts towards xeric vegetation[6,8,14]

* Factors presented are those ranked highest by habitat experts. A full list of evaluated factors can be found in the Riparian Habitats Climate Change Vulnerability Assessment Synthesis.

Snowpack depth & timing of snowmelt/ runoff	Snowpack and snowmelt contribute to soil moisture, groundwater recharge, and increased base flows, especially at high-elevation sites.[15] Reduced snowpack and earlier snowmelt could contribute to: • Compositional shift towards xeric species[7] • Losses or compositional shifts in species that depend on spring flooding and/or cold-water habitat created by snowmelt[5]
Low stream flows	Changes in the timing and magnitude of stream flows are associated with changes in precipitation, temperature, snowpack, and other climate drivers.[7,16,17] Low flows may cause: • Compositional shifts towards xeric vegetation and associated bank erosion in meadows[6–8] • Decreased stream connectivity, impacting aquatic species[7,8] • Loss of salmonids due to increased water temperature [6] • Declines in amphibian reproduction associated with decreased habitat[6]
DISTURBANCE REGIMES Moderate Sensitivity  Moderate Confidence 	
Flooding	Flood events are the dominant geomorphological drivers in riparian habitats, and can have both positive and negative impacts on the habitat, depending on the frequency and severity of floods, as well as whether the area has recently burned or is already degraded.[5–8,18,19] Future shifts in flooding regimes may cause: • Potential loss of groundwater-dependent vegetation in areas of heavy sediment deposition[8] • Increased bank erosion, channel incision and/or sedimentation, although deposited sediments can also rebuild downstream riparian habitats[2,6] • Decreased water quality due to suspended sediment and/or contaminants[10] • Decreased reproductive success of fish and amphibians where eggs are lost[6] • Extirpation of aquatic species[19] • Possible mortality and/or selective pressure against invasive species[20,21]
Wildfire	The impact of wildfire on riparian habitats is associated with fire severity, as well as the occurrence of post-fire rainstorms.[19,22] Impacts can include: • Loss of riparian canopy and changes in soil structure[18,22] • Flash flooding and debris flows in recently burned areas, leading to severe erosion and sediment scouring and/or deposition[23,24] • Shifts in species composition and/or extirpation of local populations due to changes in habitat structure and water quality[18,25]
NON-CLIMATE STRESSORS Moderate-High Sensitivity & Exposure  High Confidence 	
Dams & water diversions	Dams and water diversions reduce flow volume and variability in order to maintain reservoir storage and water delivery.[5,7] The loss of fluctuating stream flows and natural flooding regimes alters the dynamic processes that contribute to the physical structure and biodiversity of riparian ecosystems.[5,7]

Invasive & problematic species	Shifts in climate conditions can allow invasive plants to establish or expand into riparian habitats where they compete with native plants and wildflowers and increase evapotranspiration, which speeds drying and makes conditions even more suitable for invasion.[26] Invasive fish and wildlife species can also alter competition and/or predation dynamics, changing species composition.[21]
Land-use conversion	Many riparian habitats have already been converted for agricultural or development purposes.[3,12] In addition to direct loss of habitat, riparian habitats are affected indirectly by changes in hydrology associated with development.[3,10,22,27]

Exposure†

High Exposure

Moderate Confidence

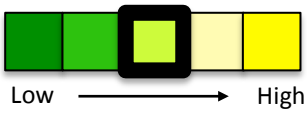
Riparian habitats are likely to be exposed to changes in precipitation, drought, snowpack depth, timing of snowmelt/runoff, and stream flows over the coming century. These hydrological changes will likely increase the climatic water deficit over the next 100 years,[28,29] resulting in the probable loss of additional riparian habitat area. Many riparian habitats serve as refugia, and springs and spring-fed creeks tied to a long-term stable groundwater source are particularly resistant to changes.[3,9,30,31]

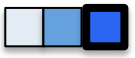
Projected climate and climate-driven changes for Southern California

Climate Drivers	Projected change
Precipitation	Variable annual precipitation volume and timing; decreased soil moisture, especially in the summer
Snowpack depth	Up to 50% reduction in snowfall and 70% reduction in snowpack by 2100 (greatest loss in low elevations)
Extreme high flows	30-40% increase in flash floods in small river/stream basins; possible changes in storm frequency

Adaptive Capacity‡

Moderate Adaptive Capacity





High Confidence

Large areas of riparian habitat have already been lost, including historical wetland complexes comprised of hundreds of vernal pools.[4] Much of the existing riparian habitat has been degraded, especially in low-elevation areas where anthropogenic use is particularly high.[32] Heavily altered habitats have a reduced capacity to support native fauna and flora, and are more susceptible to invasive species.[32] While riparian habitats are well adapted to variable

† Relevant references for regional climate projections can be found in the Southern California Climate Overview (http://ecoadapt.org/programs/adaptation-consultations/socal).

‡ Please note that the color scheme for adaptive capacity has been inverted, as those factors receiving a rank of "High" enhance adaptive capacity while those factors receiving a rank of "Low" undermine adaptive capacity.

hydrological regimes, systems that have already been impacted can be very slow to recover and may require active management interventions to restore ecological processes.[6] However, the variable conditions and isolated nature of habitats such as vernal pools and springs has given rise to very high levels of endemic and specially adapted species, and these habitats frequently serve as biodiversity hotspots.[1,3]

Habitat adaptive capacity factors and characteristics[§]

Factors	Habitat Characteristics
Habitat extent, integrity, & continuity Low-Moderate  High Confidence 	+ Isolated systems have given rise to many endemic species with specialized adaptations[1] - Riparian systems are naturally patchy and/or isolated[1] - Large areas of habitat have already been lost or heavily impacted, and remaining habitat has low connectivity[4]
Landscape permeability Low-Moderate  High Confidence 	- Geologic features act as a barrier to species movement, including migration and dispersal - Dispersal may also limited by factors such as land-use conversion, transportation corridors, grazing, dams and water diversions, and agriculture
Resistance & recovery Moderate  Moderate Confidence 	+ Disturbance-adapted community with high habitat heterogeneity + Native species may be better suited than invasive species to fill the niche left vacant by large disturbance events such as flooding[33] + Wetlands connected to deep groundwater sources are fairly resistant to climate stressors [9] - Heavily impacted areas may not be able to recover without management intervention[34]
Habitat diversity Moderate  High Confidence 	+ High species diversity, including many rare, endemic, and threatened or endangered species[1,3] + Some fish and invertebrates may only be found within a single spring system[3] - Low-moderate physical and topographical diversity - Small, isolated habitats (e.g., springs) often do not support many different species within a functional group[3]

[§] Characteristics with a green plus sign contribute positively to habitat adaptive capacity, while characteristics with a red minus sign contribute negatively to habitat adaptive capacity.

Factors	Habitat Characteristics
Management potential Moderate  Moderate Confidence 	+ Moderate societal value: Valued for biodiversity and endemism, wildlife support, recreation, open space, and scenery (e.g., wildflowers) + Provides key ecosystem services: water supply, flood/erosion protection, and sediment transport - Potential conflicts with urban communities for use of springs and other water resources

Recommended Citation

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This document is available online at the EcoAdapt website (http://ecoadapt.org/programs/adaptation-consultations/socal).

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